

THROUGH-DISPLAY WIRELESS CHARGING

BACKGROUND

[0001] Personal electronic devices may include a variety of portable devices that may be carried around users to provide communications, computing, and similar functions wherever a user may be. Such devices are typically battery powered. Modern personal electronic devices may be used with a variety of accessories, which may themselves also be battery powered. For example, personal electronic devices such as smartphones, tablet computers, and even laptop computers may be used in conjunction with accessories such as smart watches, wireless earphones/earbuds, styluses, and the like. In at least some applications, it may be desirable for personal electronic devices to provide the capability to charge associated accessories. In some embodiments, such charging may be provided by a wired connection between the personal electronic device and the accessory. In other embodiments, such charging may be provided by a wireless connection between the personal electronic device and the accessory.

SUMMARY

[0002] For at least some applications, it may therefore be desirable to provide enhanced configurations of personal electronic devices to allow for more reliable and/or convenient wireless charging. In one embodiment, such a configuration can include a tablet computer or smart phone that is configured to allow for a stylus or other accessory to be wirelessly charged on a face of the personal electronic device, e.g., through a display of the personal electronic device.

[0003] A personal electronic device may be configured to provide wireless charging to an accessory. The personal electronic device can include an enclosure containing components of the personal electronic device. The enclosure can include at least one component defining a face of the enclosure, wherein at least a portion of the face may be transparent to facilitate viewing of a display of the personal electronic device. A wireless charging assembly may be disposed within the enclosure. The wireless charging assembly can include a core having one or more windings disposed thereon, which may be configured to generate a magnetic flux above the face to couple to the accessory, thereby providing power wirelessly to the accessory when the accessory is disposed at a predetermined location on the face of the enclosure.

[0004] The enclosure may be defined by a top glass forming the face, a perimeter frame forming sides of the enclosure, and a back forming a surface opposite the face. The perimeter frame may be metallic or may be made from another material, such as plastic. The back may be glass or may be made from another material, such as plastic or a metal.

[0005] The of the wireless charging assembly may a pot core or a modified pot core. The core may also be of other shapes, such as a PQ core. The one or more windings may be disposed on one or more posts of the pot core. Additionally or alternatively, the one or more windings may be disposed on another portion of the pot core, such as a central portion between the posts. The one or more windings can include a winding having a first portion wound in a first direction (e.g., clockwise) about a first post of the pot core

and a second portion wound in a second direction (e.g., counter clockwise) about a second post of the pot core.

[0006] The personal electronic device can further include a metallic shield disposed about the wireless charging assembly. The magnetic shield may surround multiple sides of the wireless charging assembly, including five sides, four sides, or fewer sides. The wireless charging assembly of the personal electronic device may further comprises a spacer disposed between posts of the core and configured to provide mechanical reinforcement to the core. The spacer may be bonded to the core.

[0007] A wireless charging assembly may be configured to provide accessory charging in a personal electronic device. Such a wireless charging assembly can include a core configured to be disposed below a display face of the personal electronic device and one or more windings disposed on the core and configured to generate a magnetic flux above the display face, thereby providing power wirelessly to an accessory when the accessory is disposed at a predetermined location on the display face. The core may be a pot core or a modified pot core, or other core design, such as a PQ core. The one or more windings may be disposed on one or more posts of the pot core. Alternatively or additionally, the one or more windings may be disposed on another portion of the core, such as a central portion of the pot core located between the two posts. The one or more windings can include a winding having a first portion wound in a first direction (e.g., clockwise) about a first post of the pot core and a second portion wound in a second direction (e.g., counter-clockwise) about a second post of the pot core.

[0008] The wireless charging assembly can further include a metallic shield disposed about the wireless charging assembly. The metallic shield may surround a plurality of sides of the wireless charging sides, including five sides, four sides, or fewer sides. The wireless charging assembly may further include a spacer disposed between posts of the pot core and configured to provide mechanical reinforcement to the core. The spacer may be bonded to the core.

[0009] A tablet computer may be configured to provide charging of a stylus through a display glass of the tablet computer. The tablet computer can include an enclosure defined by the top glass, a perimeter frame, and a back, with the enclosure containing components of the tablet computer. The components may include a wireless accessory charging assembly including a core disposed below the top glass and one or more windings disposed on the core and configured to generate a magnetic flux above the top glass, thereby providing power wirelessly to the stylus when the stylus is placed at a predetermined location on the display face. The tablet computer may further include one or more locating assemblies, such as magnets, configured to secure the stylus in the predetermined location. The perimeter frame is metallic or may be a non-metallic material such as a plastic. The back may be glass or may be another non-metallic material, such as a plastic, or may be formed of a metallic material.

[0010] The wireless charging assembly contained within the tablet may a pot core or a modified pot core. In such case, the one or more windings may be disposed on one or more posts of the pot core. Alternatively or additionally, the one or more windings may be disposed on another portion of the pot core or modified pot core, such as a central portion of the pot core located between the two posts. The one or more windings can include a winding having a first portion wound in a first direction about a first post of the pot core and a